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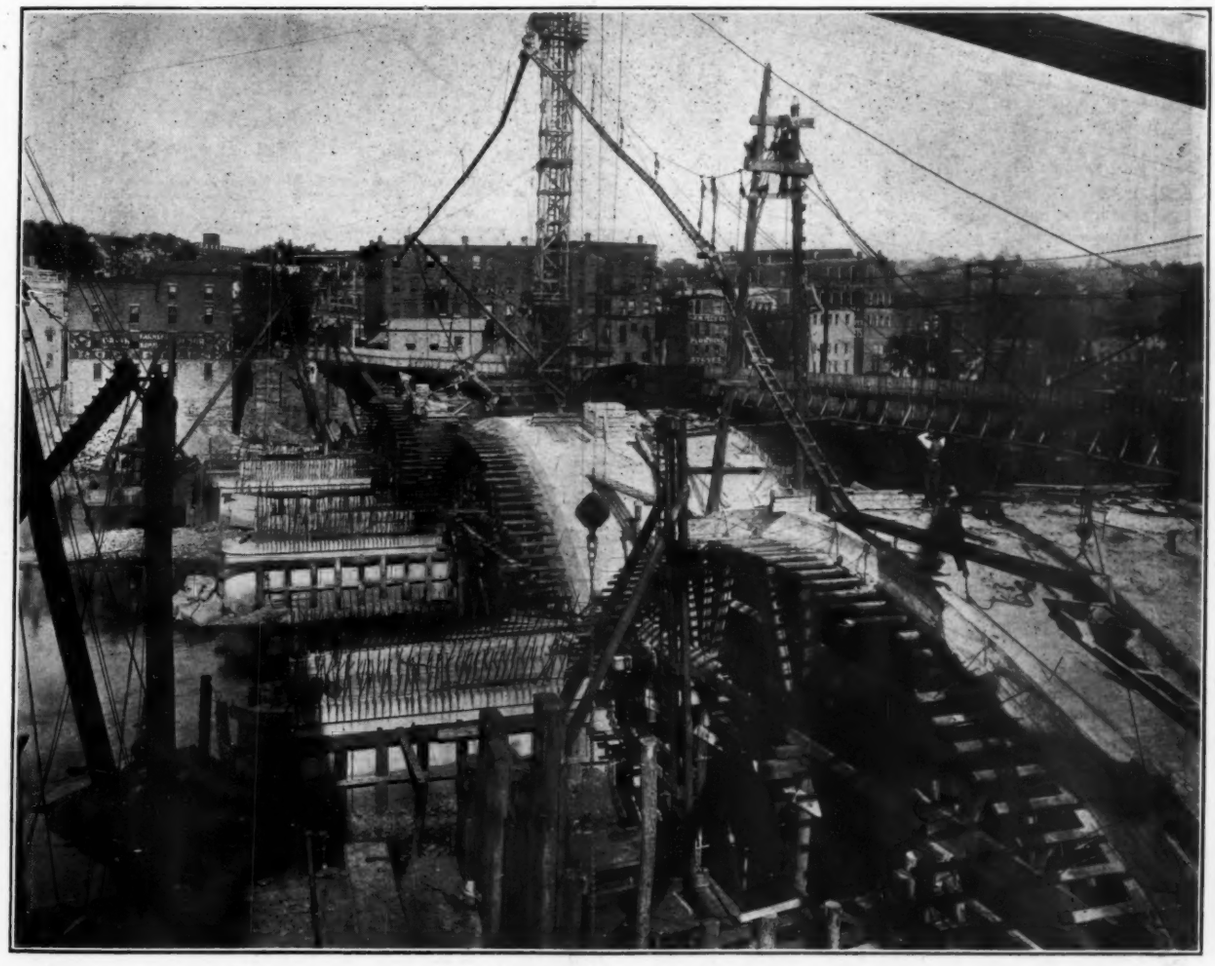
CITY COUNTY STATE



CONCRETE ARCHES REPLACING OLD PLATE GIRDER ARCH SPANS ACROSS HOUSATONIC RIVER

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OCTOBER 1, 1921

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PUBLIC WORKS.

CITY COUNTY STATE

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Street Paving in Martinsville

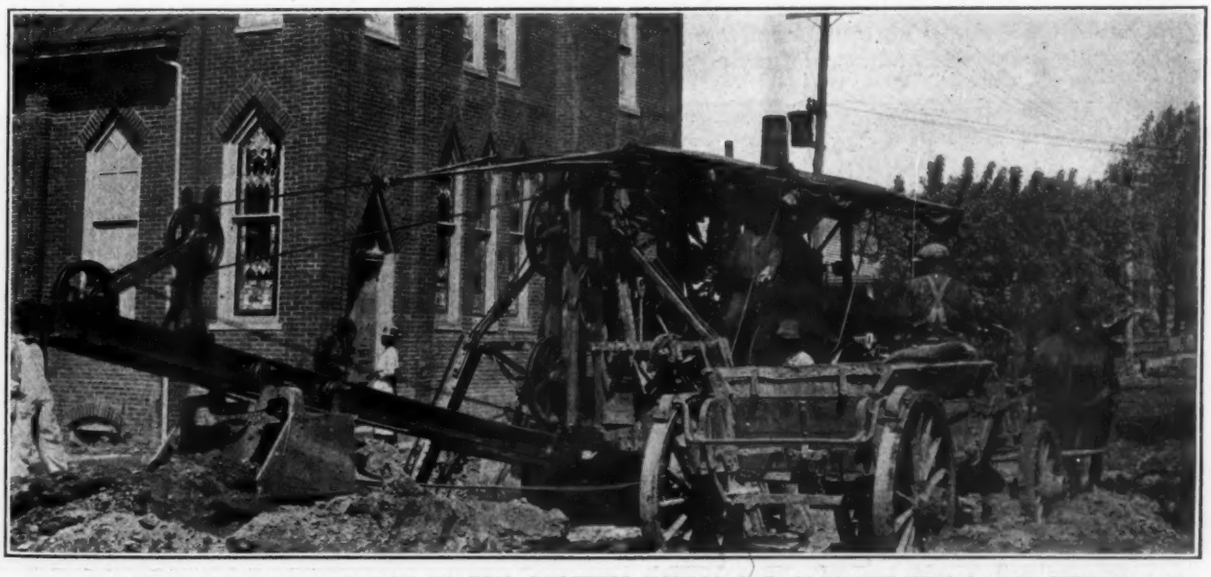
Old Macadam up to two feet depth removed by grading shovel, but cheap labor causes more hand work than formerly Concrete base thin because foundation unusually good. Distribution from central plants by one-horse carts.

Martinsville, Va., a town of about 4,000 inhabitants, is now engaged in carrying through a paving program, costing about $200,000, which will give a hard surface pavement for nearly every main street—in all about 3½ miles. Previous to this, Martinsville has had no paving, with the exception of some macadam on the principal streets, laid years ago and now entirely worn out. For the most part the new pavement consists of bitulithic on a concrete base, the remainder being bitulithic on old macadam, and a small amount of roughened concrete on the steeper streets. The work also includes considerable grading, some storm sewers, and about 8 miles of curb and curb and gutter. The work will be finished in the early fall.

The methods employed in the work are of interest as marking on another job the return to "man" days as contrasted to "machinery" days. Not all, of course, of the work is being done by hand, but men are plentiful and labor saving devices, with one or two fairly regular exceptions, are not in evidence. The use of a steam shovel for grading and motor trucks for hauling are more in the line of regular equipment than of labor saving devices. In all, about 200 men are employed on the work at an average wage of $2 per day each.

The paving to be done totals about 50,000 square yards of bitulithic surfacing two inches thick at $1.89 per square yard; about 50,000 square yards of 4-inch concrete base at $1.15; approximately 15,000 cubic yards of grading at $1 per yard; 23,000 feet of curb and gutter combined, at $1 per running foot; about 1,500 feet of storm sewer and 23,000 feet of granite curbing.

Grading is done by means of a Keystone grading shovel, equipped with a ⅜-yard bucket. Most of the excavation runs about 18 inches in depth, rarely more, but at times less. On average work, the Keystone shovel has turned out 300 to 400 yards a day. Watson 1½-yard wagons are used for nearly all hauling work. The shovel usually feeds two buckets to each wagon. The average time required to fill each wagon was 2 minutes,



LOADING OLD MACADAM INTO WAGON; SHOWING HOW MACADAM BROKE INTO LARGE PIECES

not counting the time lost in moving or for other purposes. The number of teams required depended, of course, on the length of haul. Generally 6 to 8 teams were used to haul the material excavated by the shovel.

Most of the streets to be cut down are very hard to break up, as they have been maintained in the past by superimposing layer upon layer of macadam, until in some places they are 12 to 18 inches above the sidewalks. Occasional concrete cross-walks are encountered 12 to 15 inches underground.

As a rule, the street is cut to a few inches below grade, and the loose earth which piles along the sides just out of reach of the shovel is used as fill to bring it to the desired grade. Most of the streets are rather narrow, and the shovel easily cuts the entire width.

Following the shovel comes the first of the fine grading gang. These heap the excess material into windrows, meanwhile bringing the street to approximate grade and shape. These windrows are then handled by a team of mules and a jump scraper, and the material either used for fill where needed or wasted. The final finishing gang completes the street section, all work being done by hand.

Curbing and guttering are usually done in advance of the grading. The trench is excavated by hand work to the required size and grade, the forms are then set and the concrete poured. Wood forms are used exclusively. Curb protection bars are embedded at the corners. Concrete for the curb and curb and gutter is mixed in a Jaeger portable mixer, which is set up at convenient intervals, and is handled in steel body wheelbarrows. The concrete mixture for the curb and curb and gutter is the same as for concrete base, 1:3:6, but a half-inch facing of 1:2 mortar is used.

Considerable granite curb was already in place, in which case only gutter was built, the curb being reset where necessary.

The concrete base is only 4 inches in thickness and the mixture 1:3:6. This combination is usually considered rather light for modern traffic but the base foundation is quite uniformly good, and is carefully prepared in advance of laying the concrete, while the traffic is generally not very heavy in weight per wheel. Local sand is used, with Atlas portland cement and a good quality of blue trap for coarse aggregate.

Sand is dredged from a local creek, elevated into bins and loaded into motor trucks to be hauled to the city. Indiana trucks are used chiefly and are hired by the owner of the plant. The paving contractor buys the sand delivered on the job.

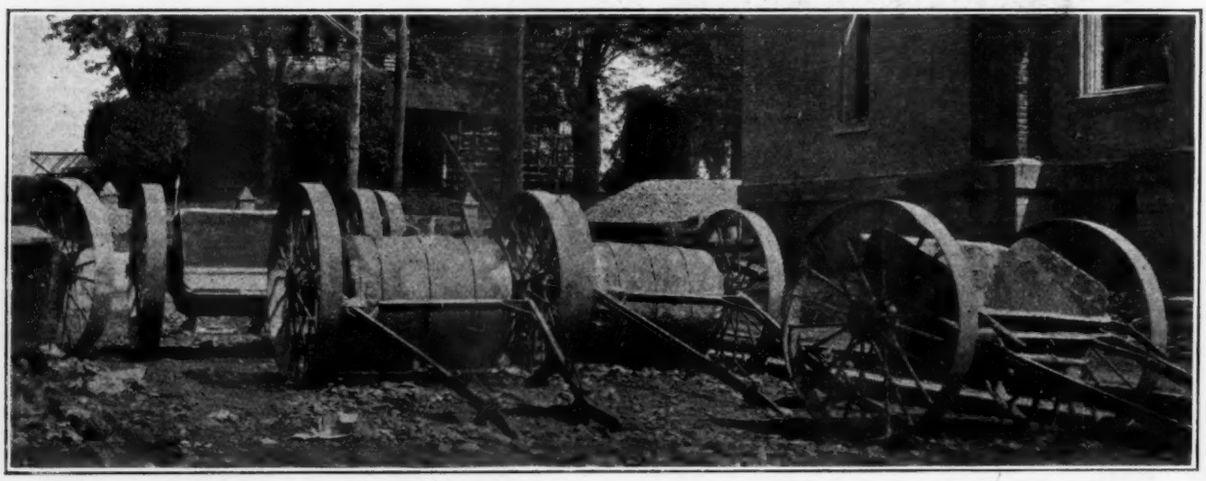
Stone is shipped in from the Bixley quarries and is unloaded in a converted coal shed, the trestle being boxed underneath and chutes installed so that the stone is dumped from the cars into the bins and discharged, all without handling, into the wagons. Teams, which are hired at $7.50 per 10-hour day, are used for stone hauling. Snatch teams are necessary on the steeper grades.

The method of handling the concrete for the base is somewhat unusual. At several points throughout the city, sand and stone are piled in large quantities. The mixer is set up at these points, and used as a central plant for furnishing concrete for all work within a radius of 500 to 1,100 feet.

The concrete is discharged from the mixer into 2-wheel steel carts, holding about a yard, to which a single mule is attached. These carts are hauled to the point desired and dumped, the concrete spread, and the cart returned for another load. An easy-dumping device makes the cart easy to handle and saves time in dumping.

By this means, base can be laid economically up to 600 feet from the mixer. It has been found necessary to work, at times, up to 1,000 or 1,100 feet from the mixer to save another move, but 600 feet is about the economical limit of distance. This method provides a simple means of employing the central plant principle without costly equipment.

The mixer used is an old Foote, which has been in use about nine years. Aggregate is handled from the piles to the mixer by means of steel barrows. The concrete carts are of steel, with metal wheels, shafts for one horse, and a metal body.



CARTS USED IN HANDLING CONCRETE FROM MIXER FOR LAYING BASE

The wearing surface is bitulithic laid in two courses, with a total thickness of two inches. Sand and stone are secured from the same sources as the aggregate for the concrete base, but is handled differently. The cars containing stone are dumped, as far as this is possible, in a flat track, and the stone shoveled from underneath them by hand, and then moved by slip scrapers to the elevators of the mixers. Sand is haulel to the job by trucks, dumped nearby, and also handled by scrapers.

A Warren portable plant is used for mixing the bitulithic. At present this plant operates by coal, though it may be changed over to burn oil. The daily capacity under the present arrangement is about 1,600 square yards of pavement.

The lower or binding course of pavement is the regular bitulithic, with aggregate passing 1⅛-inch screen; the top coat is regular graded sheet asphalt mixture with ¼-inch stone. The top coat varies in thickness from ¼ to ½ inch.

Hot stuff is hauled from the mixing plant, located on a siding at the railroad, to the job by two rented White trucks of 2 and 3½ tons capacity, respectively. On a haul of about a mile these two trucks recently hauled 204 tons of hot mix from the plant to the job in a 10-hour day. The trucks are usually loaded one ton in excess of their rating.

The specifications require that the hot material be dumped on a platform and then spread by shovels onto the base. Instead of the usual platform of planks, Superintendent Gassaway has an 8 x 8-foot plank platform mounted on very small, but solid, wooden wheels about 8 inches in diameter. This platform is equipped with a tongue and can be steered and handled easily.

The material is removed from the platform and spread over the concrete base, which has been thoroughly cleaned, by hand. It is compacted by a 10-ton Buffalo-Springfield roller with extra wide wheels.

On September 1, the work was about 60 per cent completed and was going forward rapidly. The contractor is the Atlantic Bitulithic Company of Richmond, Va., H. C. Gassaway, superintendent. Taplin & Perkins, of High Point, N. C., are the consulting engineers, with H. B. Ingram as resident engineer. J. R. Gregory is engineer and superintendent of the city, and J. F. Brown is mayor.

PORTABLE PLANT MIXING ASPHALTIC MATERIAL FOR WEARING SURFACE

Highway Engineering Fellowships

Our attention is called by Professor Blanchard to the fact that the highway engineering and highway transport fellowships in the University of Michigan are to be awarded not later than November 1, there being one fellowship in highway transport and three in highway engineering. Each fellowship pays $250 with an allowance of $50 for expenses and the holders of the fellowships do not have to pay tuition fees. Each fellow must hold a bachelor's degree and enroll as a graduate student in highway engineering or highway transport and as a candidate for the degree of master of science. He must be in residence at the college for four or five months during the college year. Applications for fellowships may be addressed to Professor Arthur H. Blanchard, University of Michigan, Ann Arbor, Mich.

Conference of New England Highway Officials

The Safe Roads Federation of Massachusetts has called a conference of the state highway commissioners and registrars of New England to discuss, among other problems, standardization of highway traffic regulations. The conference will meet in the State House in Boston on September 30 and will be presided over by John M. Cole, state commissioner of public works.

Public Work for Unemployed

The chief engineer for Middlesex county, England, Alfred Dryland, who recently arrived in this country to inspect American highways, says that 36 miles of arterial hard-surface roads are being built in the environs of London to cost about $6,000,000. This work is being undertaken at this time to afford employment to thousands of former service men and he believes that American state and city highway departments could do nothing more practical or patriotic than to give work to unemployed former service men in the construction of roads and similar public improvements.

Incidentally, Mr. Dryland believes that roads in America are altogether too narrow. He says: "Your roads are dangerous because the paved widths are too narrow for the amount of traffic they bear. There should be a minimum width of 30 feet of pavement, affording room for at least three vehicles to pass." Presumably he is referring to roads in the immediate vicinity of New York and does not refer to highways outside of the metropolitan districts. For to construct all of our highways throughout the country of that width would unnecessarily restrict the mileage that could be constructed with the funds, materials and labor available.

T. H. MacDonald, Chief of the United States Bureau of Public Roads, states that immediately after the expected passage of the highway bill now before Congress, construction will be commenced on a large number of new projects, particularly in the west, where unemployment is

acute, and the prospects are for an unprecedented amount of road construction this year, even exceeding that in 1920, which was far greater than ever before.

Mending a Leaky Stave Pipe

A wooden stave water main in Norfolk, Va., is 24 inches in diameter and about 10 miles long, with pine staves 2 inches thick, machined, wound with 14-gage wrought iron bands ¼ inch apart. It was completed in 1913 and operated under a pressure of about 20 pounds until 1918 when an examination and test showed that the weight of the two-foot fill above the pipe had flattened the cross-section to an elliptical shape, and a pressure of 21 pounds per square inch caused an almost continuous leakage amounting to 2,400,000 gallons per day in the first 24,000 feet length of the pipe.

The pipe was then reinforced by ⅝-inch circumferential rods with malleable iron lugs. The joints at the ends of the staves were scraped all around the pipe and for a width of 12 inches calked with lead wool. They were then covered with a strip of rubber 1½ inches wide and ¼-inch thick, around the entire circumference except for a 6-inch space at the top between the ends of the rubber, where double iron lugs were seated and received the ends of a 3/16 x 1¼-inch steel band flattened from a ⅝-inch rod, one end of which was riveted to the lug and the opposite screw end secured to the lug by a nut. As the nut was tightened the bar was hammered until the joint leaks were closed. The joints were about 8 feet apart and 25 of them were repaired daily by two men. The subsequent test showed the leakage of 1,700,000 gallons daily in the first 11,000 feet of pipe under a pressure of 29 pounds, increased to 4,600,000 under a pressure of 30 pounds. In the first 6,500 feet of the pipe, which had been almost continuously reinforced by the ⅝-inch rods, the leakage was only 43,000 gallons daily under 42 pounds pressure and 1,100,000 gallons daily under 64 pounds pressure.

Biological Survey of River Pollution

Indications of pollution and self-purification of Sangamon river in a distance of seventy-five miles as given by the animal and vegetable contents of water and bottom mud. Conclusion therefrom. Investigation by Illinois State Water Survey.

An interesting investigation was concluded about two years ago by Minna E. Jewell, chemist connected with the Illinois State Water Survey, and described in the report of that survey for the years 1918 and 1919, which has recently been published. General interest attaches to this report because of the attention which it calls to the use of biological surveys of river water and biological and chemical analyses of the mud at the river bottom as a means of judging the amount of pollution and self-purification of a river receiving sewage.

The survey referred to was made of the Sangamon river between Decatur and Springfield. The river is normally a small stream consisting of alternate pools from three to ten feet deep and riffles a few inches deep. The water reaches Decatur in a relatively normal, unpolluted condition and provides the public water supply of that town. In dry weather Decatur uses all of the water in the river so that none whatever flows past the city, but most of it is returned to the channel as crude, undiluted sewage. As the river receives no important tributaries for at least 100 miles, the changes that take place for that distance below Decatur are primarily those due to so-called self-purification.

A biological survey was made of the river above Decatur in order to ascertain the normal inhabitants of the stream and their abundance. Above Decatur the pools had a gravel bottom frequently covered to a depth of several inches by a deposit of fine sand, soil and decaying leaves. They contained an abundance of clams, of which eight species were noted, while a typical square yard of bottom from a riffle was estimated to contain 40 snails, 3 clams, 40 insect larvae, 30 ephemerid nymphs and 10 coleopterous larvae. Numerous fish 12 to 16 inches long could be seen swimming a short distance below the surface. The sewage of the small town of Monticello is discharged into the river after preliminary treatment in a septic tank but the effect is purely local, disappearing entirely within ¾ of a mile.

An examination of the river was made on October 5 to 8, and the appearance one mile below Decatur was that of sewage, 6 miles below it was inky, 20 miles below inky but opaque, 35 miles below dark slaty, 50 miles below milky, 60 miles below gray and turbid, 70 miles below greenish-gray and 78 miles below green. The odor was described as putrid 6 miles below, septic from 20 to 39 miles below, disagreeable at 53 miles, faint at 70 miles, noticeable at 75 miles, above a dam, and had entirely disappeared ¼ of a mile below this dam. Dissolved oxygen was entirely absent for 35 miles below Decatur, a trace was found at 39 miles, which had disappeared at 60 miles. At 75 miles below, 4.1 parts per million were found above the dam and 7.8 parts just below the dam, increasing to 9.7 parts 3½ miles below the dam.

Immediately below Decatur there was a complete disappearance of bottom animals and these did not make their first appearance until 30 miles below and even there only the tubificid worms

were found, which are capable of living in the complete absence of free oxygen and are typical sludge worms. Twenty miles farther down the chironomid larvae were found, these also being capable of anaerobic existence. Soon after the first crayfish appeared, but no other bottom forms were found until 75 miles below Decatur. At 60 miles a few fish were found that had entered from a small tributary creek, but these were dying or showing signs of great distress. Seventy-five miles below Decatur is the dam above referred to, about 8 feet high, and as the water flows over this, considerable mechanical aeration is obtained. Above the dam the dissolved oxygen analysis showed 48.9 per cent saturation while ¼ of a mile below there was 93 per cent of saturation. Immediately below the dam there was a return of the normal animal life, but this and the dissolved oxygen again disappeared a few miles further on, which was explained by the supposition that sufficient putrescible matter remained in the water to absorb the oxygen mechanically introduced at the dam. A little distance further on, however, the river permanently recovered its normal condition.

Discussing the results of the survey, Miss Jewell reports that "the plankton of a stream afford a good criterion of the quality of the water at the time it is collected. On the other hand, the bottom animals offer a criterion of the worst condition to which the locality is subject." The biological and chemical survey showed:

"1.—Plankton animals present varied greatly with season and water level. During the low waters of early fall only sewage and highly tolerant forms were found within 75 miles (by river) of Decatur.

"2. The normal bottom fauna disappeared entirely below Decatur. Only typical sludge worms (tubificids) were found in the first 40 miles. The highly tolerant midge larva appeared within the next ten miles. Seventy-five miles below the source of pollution several of the normal bottom animals reappeared and about 10 miles further down the normal bottom fauna was re-established.

"3. Dissolved oxygen drops off, frequently to zero, below Decatur and at low water sufficient oxygen to support ordinary aquatic animals is not found again within 75 miles.

"4. Oxygen consuming power of the water, organic nitrogen and ammonia rise rapidly immediately below Decatur and then gradually decrease to normal.

"5. Dissolved oxygen consumption, organic nitrogen and ammonia of the water fluctuate greatly with the temperature and volume of the stream.

"6. Ammonia content of mud from the bottom of the river increases suddenly below Decatur and then decreases gradually to normal (about 80 miles below).

"7. The ammonia content of the mud from any given location shows a seasonal variation due to temperature and oxygen content of the water. Slight temporary fluctuations in water level do not appreciably affect the ammonia content of the mud.

"8. The worst conditions occur in the upper part of the river during hot, dry summers, and in the lower part of the river in the early spring following a severe winter.

"9. Chemical analyses of the water and mud afford the best criterion for the degree of pollution of the water at the time the sample is taken. The animals of the bottom form the best criterion for judging the worst conditions to which the location is subject."

Sanitary Engineers of the U. S. Public Health Service

Until about eight years ago the United States Public Health Service functioned entirely through members of the medical profession in all its grades, but at that time it began utilizing sanitary engineers and the number of these has increased until 27 sanitary engineers are now connected with the Public Health Service.

However, the medical officers of the service are commissioned, while the sanitary engineers are on a civil service status and are, therefore, subject to dismissal whenever congressional appropriations for special work fail to be made. Consequently the engineers now in the service do not feel secure of their positions and it is hardly to be expected that young engineers would be attracted to the service under such conditions. Moreover, engineers in charge of public health service work sometimes are unable to command the respect from citizens that they would receive if commissioned as are the medical officers.

On July 1 a bill was introduced in Congress to commission the sanitary engineers on the same basis as the medical officers. This bill is before the Interstate and Foreign Commerce Committee of the House and it is expected that it will be brought up for consideration when Congress convenes after the recess. The Surgeon-General is reported to have said that "it is the desire of the bureau that any reorganization bill should provide for the commissioning of the engineers of the service." The Treasury Department has gone on official record as stating: "Legislation which would enable sanitary engineers to be commissioned in the Public Health Service on the same status as medical officers would benefit public health work and attract competent sanitary engineers who wish to make a public health career their life work." The Surgeon-General, in his report for the year ending June 30, 1920, reported that resignations of engineers from the service had exceeded admissions during the previous twelve months.

The bill does not involve any additional expense to the service, the sanitary engineers at present receiving compensation equivalent to that of medical officers in the service of the same grade.

Touring Hetch Hetchy Water Supply

The Yosemite National Park Company has opened at Mather, Cal., the Hetch Hetchy Lodge with dining room and sleeping accommodations for 30 people to serve as a base for motorists to take the White buses operated with flange wheels

on the Hetch Hetchy Construction Railroad that in 68 miles makes 98 complete circles of curvature, overlooks the beautiful Tuolumne canyon, and enables the tourists to visit the dam site and the long tunnel under the Sierra Nevada mountains and return the same day.

Insuring Purity of Plattsburg's Water

Recommendations of consulting engineers for chlorinating, algae removal, and cleaning of distributing reservoirs.

In a recent report on the quantity and quality of the water supply of Plattsburg, N. Y., Messrs. Metcalf & Eddy have embodied certain recommendations, and instructions for carrying out expedients recommended, for securing and maintaining the safety of the supply which will be of interest to other cities as well.

The supply is obtained from two brooks and is treated with chlorine, the water from one brook being treated by an automatic Wallace & Tiernan chlorine apparatus, while that from the other is dosed by means of a manual control apparatus. The engineers report that each piece of apparatus is capable of satisfactorily disinfecting the supply but "the point cannot be overemphasized that the apparatus must be operated uninterruptedly and sufficient amounts of chlorine be supplied at all times to show excess chlorine" in samples allowed to stand for 15 minutes after being collected. A slight excess of chlorine taken at the plant "will not appear in the water delivered to the city, due to the absorption of the chlorine by the organic matter of the water during the flow through the long lines to the distributing reservoirs."

Owing to the distance of the chlorinating plants from the city, it is impracticable for the superintendent of public works, Mr. Burke, to give this apparatus the attention it should receive and it is recommended that this be performed by an employee regularly assigned to this duty who is competent to change the chlorine cylinders, to use judgment in the application of the chlorine based upon the tests for excess chlorine (which he should make at least twice daily), to keep records of operation, and to familiarize himself with the apparatus so as to be able to make minor repairs and adjustments. This will not take up all of his time and he could also be instructed to attend to the regulation of the valves in the pipe lines at and near the reservoirs, patrol the reservoirs, assist in reforestation work and perform other duties in the vicinity of the reservoirs.

The reservoirs at the intakes are shallow and considerable trouble has been experienced with tastes and odors due to algae growths. "It would be possible to obviate to a considerable degree the troubles arising from such algae growths by the application of proper amounts of copper sulphate to the reservoirs in late spring or early summer and by repeating such application at regular intervals during the summer months." The engineers do not recommend such treatment late in the season, however, when the growths have progressed to such an extent that the destruction by copper sulphate of large numbers of algae would temporarily cause an undesirable amount of taste and odor.

However, in the case of the distribution reservoirs, "on account of the small storage in these reservoirs and the frequent replacement of the water therein, the objection to the use of copper sulphate which exists at the present time in the case of the large reservoirs does not apply. In order to minimize the growth of algae in the distribution reservoirs and to improve somewhat the physical quality of the water in them, steps have been taken to clean them, provide additional chlorination of the water used for refilling on account of possible contamination incident to the cleaning of the reservoirs, and to use copper sulphate in the refilled reservoirs to kill the algae growths remaining on the walls. The north basin has already been cleaned and two to three inches in depth of humus matter flushed out, together with large numbers of frogs and tadpoles. The first million gallons of water admitted to this basin was given additional chlorination before any water from the basin was admitted to the distribution system, by the application of about nine pounds of chlorine. As soon as this north basin becomes filled to its normal depth of 10 or 12 feet, copper sulphate is to be applied in the proportion of one part per million by weight, or 8 1/3 pounds per million gallons of water. . . . The south basin has already received one application of copper sulphate. As soon as the north basin becomes filled, the south basin is to be emptied, cleaned, refilled, chlorinated and copper sulphate treatment again applied.

"By cleaning these distribution reservoirs, the removal of decomposing organic matter will be effected, and by copper sulphate treatment algae growths in them will be kept at a minimum. The copper sulphate treatment in the reservoirs should be repeated every two weeks until fall. While this treatment cannot affect very markedly the character of the water coming from the storage reservoirs, it will prevent additional tastes and odors developing from algae growths in the distribution reservoirs themselves."

Aeration of the supply at the distribution reservoirs would be very desirable but the necessary head cannot be spared from the city pressure.

The engineers recommend certain precautions for preventing pollution of the water that are not, we fear, always observed by other cities besides Plattsburg. "The floor of the gate house over the well into which water from the south reservoir discharges before entrance into the main to the city is of plank with open joints. These open joints permit dirt and dust carried into the gate house on the boots of the workmen and visitors to fall into the water going to the city. Such pollution can be prevented by covering this floor with a tight canvass deck and by building a raised framework for the trap doors to rest upon. Furthermore, collars should be put around the valve stems."

Crib and Cofferdam Work*

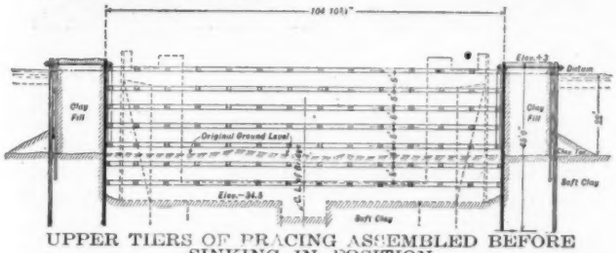
Telescopic steel sheet pile cofferdam. Design and methods of installation of interior bracing. Floating, sectional and detachable cofferdams, anchoring and sealing crib cofferdams.

The piers for the ten 160-foot spans of the concrete arch double track Tunkhannock railroad viaduct have 46 x 36-foot foundations on rock, some of them 90 feet below the surface of the ground and 60 feet below water level. They were built in telescopic sheet pile cofferdams, made with two offset tiers of steel sheet piles, the upper and outer one having inside dimensions 10 to 12 feet greater than those of the inner or lower one.

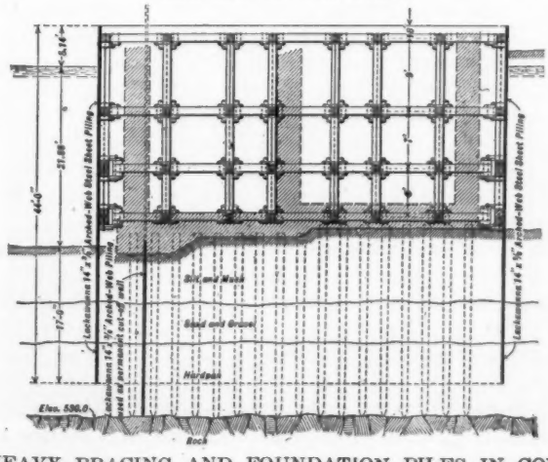
Inside and outside top and bottom waling pieces 6 feet apart horizontally and vertically were assembled to form a framework on the surface of the ground and between them there were driven to a penetration of about 16 feet the piles forming the lower section of the cofferdam.

After this was completed the piles forming the upper sections were similarly driven concentric with them, after which the space between the inner and outer piles was excavated and the space inside the inner piles having been previously excavated the inner piles were again driven and the bracing shifted downward as the excavation progressed within, and the exterior piles were again driven another 15 feet, the material between the two sets of piles was excavated, and so on, until the inner piles reached bed rock and the tops of the outer piles reached the surface of the ground, as shown in the third figure, page 197.

*Continued from page 198.



UPPER TIERS OF BRACING ASSEMBLED BEFORE SINKING IN POSITION



HEAVY BRACING AND FOUNDATION PILES IN COFFERDAM FOR CONSTRUCTION OF PUMP WELL

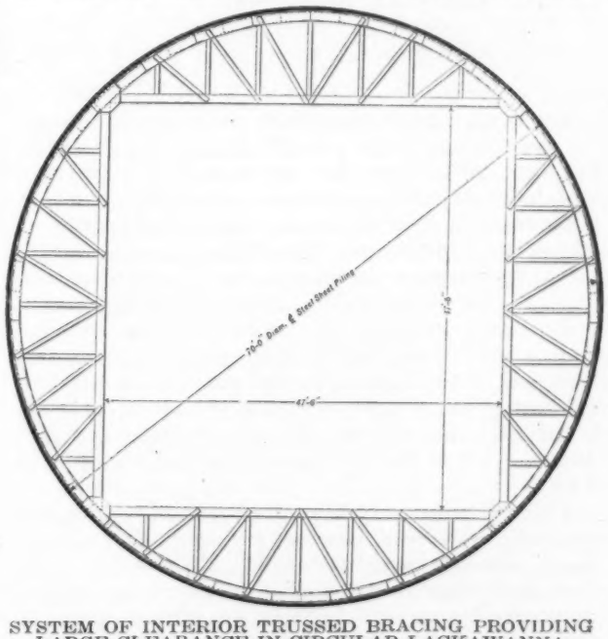
STRENGTH AND STABILITY

Where the water level is to be very much higher on the outside of the cofferdam than inside, the cofferdam must resist tremendous horizontal pressure due to the hydro-static head and provision must be made to prevent overturning, bending, and horizontal displacement. If the cofferdam is a complete enclosure a number of these forces may be resisted by heavy interior longitudinal and transverse cross struts, but these are sometimes very objectionable because of the obstruction they offer to the construction operations inside the cofferdam beside which they are likely to be complicated and costly.

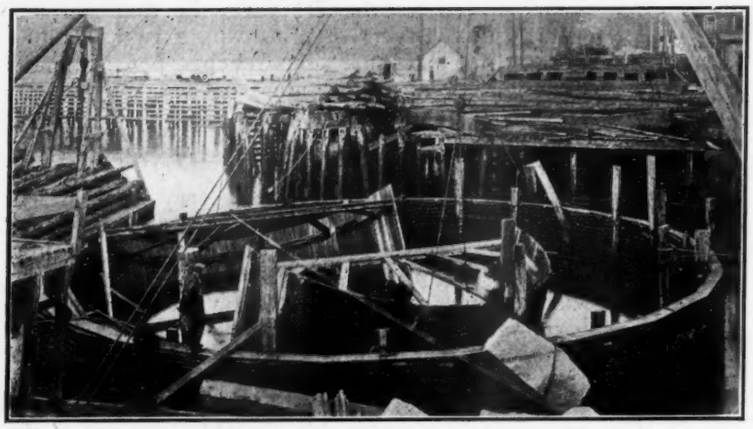
If the cofferdam is very wide it may be almost impossible to provide adequate interior bracing and in some cases of this nature the cofferdam has been made to have independent stability by building a series of interconnected cells made of interlocking steel sheet piles and filled with earth and reinforced if necessary by interior embankments.

This was the case of the famous cofferdam for the recovery of the battleship Maine sunk in Havana harbor just before the Spanish war and for the construction of Black Rock United States Government Canal Lock at Buffalo. In both cases the bottom was very soft and the water deep and long heavy steel sheet piles were driven to form a series of connected cylinders with long diameters filled with the soft excavated material.

A similar construction was also used in the cofferdam enclosing the river side of the excavation for the Municipal Piers at 43rd street, New



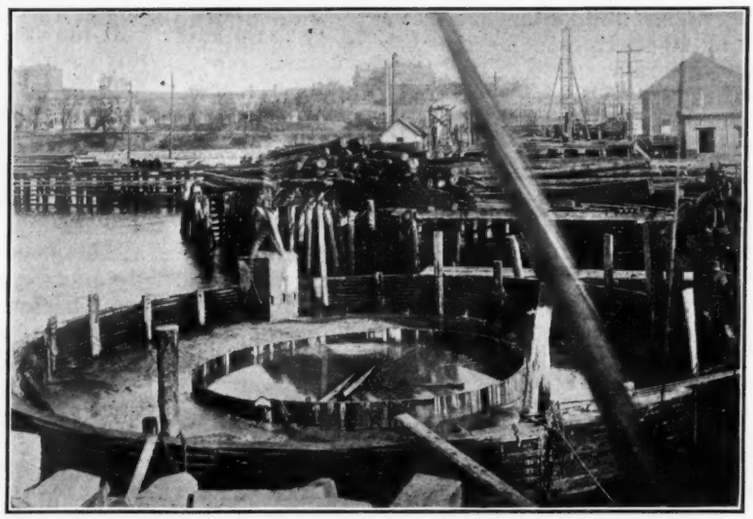
SYSTEM OF INTERIOR TRUSSED BRACING PROVIDING LARGE CLEARANCE IN CIRCULAR LACKAWANNA STEEL SHEET PILE COFFERDAM



CHELSEA COFFERDAM COLLAPSED BY HEAVY PRESSURE ON INNER WALLS

York, illustrated on page 198. In all the cases mentioned the construction was massive and expensive but efficient, the intake being so small that it was easily controlled by the pumping plant installed.

High cofferdams with short sides may have their bracing constructed complete on shore, launched, floated to position and sunk to form a guide on the exterior of which sheeting is placed or sheet piles are driven to enclose the framework and take bearing against it, or if the cofferdam is not too large, the piles may be driven and the assembled bracing placed inside by derricks before the cofferdam is unwatered. This method provides for the efficient construction and proper placing of interior framework below water level and enables the cofferdam to be unwatered without hesitation as soon as it is completed.



DOUBLE-WALL CHELSEA COFFERDAM BEFORE UNWATERING WAS COMMENCED

FLOATING AND DETACHABLE COFFERDAMS

For bridge piers, especially those that are built on foundation piles cut off below water level, floating cofferdams are sometimes provided in which construction is carried on and the structure sunk to final bearing within the cofferdam after which the cofferdam is detached and may be used again for similar structures in the same series. Such a cofferdam is also called a floating caisson and usually consists of vertical side panels with timber frames and heavy flanges bolted or hooked together with gaskets at the corners and bolted or hooked to a solid, watertight bottom that remains permanently in place supporting the pier above it when the sides are detached and floated away.

Formerly the bottoms were made of timber, but recently considerable economy and other advantages were attained by J. W. Rollins, Jr., who has done important work, for which he built a reinforced concrete bottom to which were attached with gasket bearings the detachable wooden sides thus saving the cost of constructing a temporary wooden bottom and eliminating all wood from the pier construction.

Somewhat similar to the floating cofferdams are detachable cofferdams, frequently used in the construction of foundation piers for very tall buildings where the excavation is not completed at the time the piers are built and the cofferdams attached to the tops of the piers are carried above the temporary surface of the ground to exclude earth and water and permit the framework to be constructed on the piers simultaneously with the completion of the general excavation as has been done with the Woolworth building and other office buildings in New York.

These cofferdams usually are sectional with steel panels that can be separated or moved at pleasure, or when of small dimensions, are often riveted steel cylinders. Similar cofferdams are also attached to pneumatic caissons to permit working on top of them or to serve for forms for concrete piers on land or water or for both purposes and are usually detached after the structure is finished. In large bridge piers the cofferdams are frequently confused with the caissons themselves and are even built structurally continuous with them and may be considered or referred to as either caissons or cofferdams.

Where they are built to considerable height as in the piers for the East River bridge at New York that were sunk to a depth of more than 100 feet below water level, the cofferdams were of massive wooden construction heavily braced with many tiers of cross timbers and sometimes with horizontal trusses. The thickness of the walls varied from 12 inches at the bottom to 3 inches at the top, and the upper tiers of the cofferdams were generally made detachable while the lower

tiers were made permanent and remained fixed in position when the structure was completed.

CRIB COFFERDAMS

When cofferdams have to be built in very swift water, or if the water is deep, or the bottom has an irregular surface, or is strewn with boulders, the construction of a cofferdam is very difficult, particularly if there is little or no earth available and in such case crib cofferdams are commonly used.

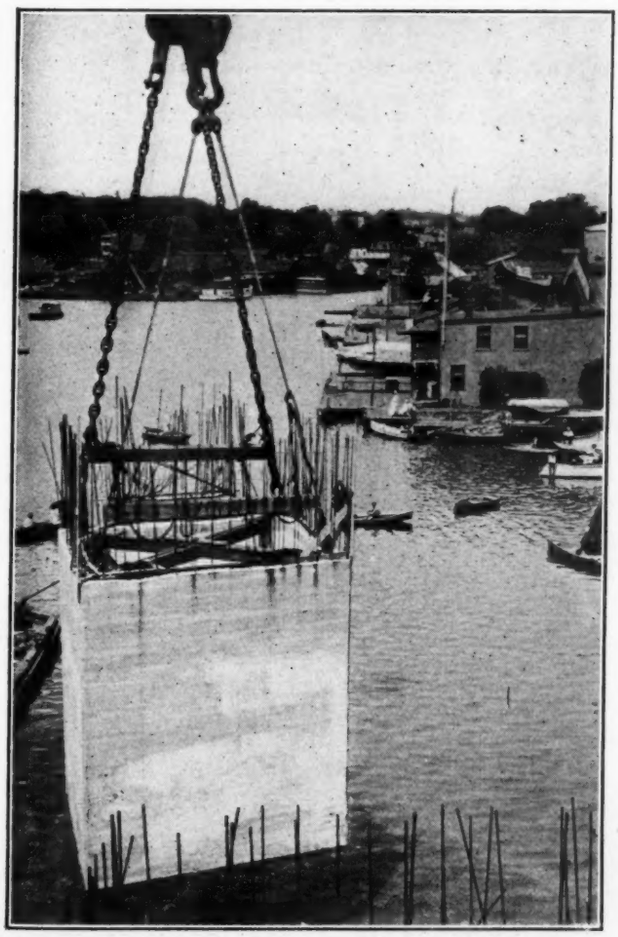
These consist simply of a rectangular framework built up of round or square timber laid together cob house fashion, and drift bolted at intersections where the timbers may be laid with whole face, notch, or half-notch bearings, making open or solid walls.

The lower courses are carefully cut to conform to a profile of the bottom as determined by careful soundings, and the cribs are either built complete on shore of small enough dimensions and swung to position by derricks or are partly built, launched and completed while floating.

In either case they are provided with interior compartments, two or more of which are floored to retain stone ballast which is filled in as they sink, care being taken to maintain them in position end to end and thus form the skeleton of the cofferdam. The cofferdam is completed by filling the cribs with earth or stone and usually depositing an embankment of earth or puddle or rip-rap or both on the upper side and if sufficient puddle clay is not available by sheeting the upper side with vertical planks, spiked or bolted to the crib under water by divers after the planks, which are often cut to chisel edge at the bottom, are driven hard to broom up against the surface of the rock and make a fairly tight joint there.

Additional tightness is also secured often by the use of an apron or heavy canvas 6 or 8 feet wide, one edge of which is securely nailed to the crib on a horizontal line just above the bottom and the remainder of the canvas spread flat on the bottom and covered with clay or earth.

Cribs can have any required dimensions that are convenient and are generally from 10 to 20 feet wide and from 10 to 40 or 50 feet in length. Ordinarily they are not more than 30 feet in height. If the bottom is smooth and regular, either horizontal or inclined, and the current is heavy, it may be necessary to anchor the cribs in position, which is sometimes done by drilling holes in the surface of the rock with submerged drills and setting in them heavy vertical steel dowel pins that project above the surface of the rock to engage the crib work.



DERRICK HANDLING 150-TON REINFORCED CONCRETE COFFERDAM IN 12 FEET OF WATER FOR PUMP WELL AT STAMFORD, CONN.

Derby-Shelton Bridge

The new bridge across the Housatonic river, between Derby and Shelton, was built by the Connecticut State Highway Department to replace an old structure with 50-foot plate girder arch spans that had become inadequate for the increasing traffic.

Steel sheet pile cofferdams were constructed adjacent to the old piers and in them excavations were carried down to a gravel stratum on which there were built the new concrete piers.

Between each pair of piers were driven five transverse bents of pile trestles that were capped about 10 feet above the spring line, where they supported longitudinal timbers carrying vertical and inclined posts supporting wooden arch ribs that extended beyond the ends of the falsework bents, to the pier coping, the projecting sections being carried by blocking on steeply inclined chord pieces, resting at the lower ends on the caps of bents seated on the footings of the piers and at the upper end seated on the inclined end of the longitudinal timbers to which they were scabbed. The transverse pile caps were double with pairs of folding wedges inserted between the upper and lower tiers, thus providing an adjustment to strike the centers after the arch was completed.

The arch rings, which were continuous cylindrical segments, were for convenience built in successive longitudinal halves, the falsework being shifted from the first to the second after the completion of the former.

The aggregate was delivered over a service track to a wooden hoisting tower located near the center of the bridge and from it the concrete was spouted to position through steel chutes suspended by light manila tackles from steel cables attached to the tower and supported intermediately when necessary on moveable A-frames.

The arches were bonded to the piers by reinforcement rods projecting from the skewback to the arch curve. Vertical reinforcement imbedded in the arch ring projected above it to bond with the reinforcement in the spandrel walls, and horizontal transverse anchor rods were also imbedded in the arch ring near the center line and projected from it to bond the first section of the arch to the second. During the removal of the old bridge and the construction of the new one traffic was maintained on an adjacent pile trestle by-pass. The new bridge was built by the Arthur McMullen Co., of New York.

A view of this bridge under construction is shown on the front cover of this issue.

Imhoff Tank Patents

Patents for the Imhoff sewage treatment tank were originally taken out by Dr. Carl Imhoff about eleven years ago, during most of which time the Pacific Flush Tank Co. has acted as commercial representative for Dr. Imhoff in the United States and Canada. When the United States entered the war, Dr. Imhoff became an alien enemy and the Federal Trade Commission permitted this company to continue to license towns in behalf of the United States government. On March 1, 1919, the alien property custodian, acting under the provisions of the Trading with the Enemy Act, siezed the Imhoff patents and sold them to the Chemical Foundation, Inc., which will continue for the life of the Imhoff sewage tank patent to issue licenses for the use of Imhoff tanks, through the Pacific Flush Tank Co. as its agent, the patents, therefore, now being owned entirely by American interests. The royalties will be the same as before, varying from $10 for a population of 100, to $430 for a population of 10,000 and up to $15,000 for a population of 2,000,000.

Newark's Garbage Piggery Bankrupt

Some months ago we published the information that Newark, N. J., had contracted with a private company for disposing of garbage at a profit to the city, this company having agreed to purchase it and intending to use it for the raising of pigs. During the first half of September the purchasing company, the National Utilization Co., notified the Department of Streets and Public Improvements that it would have to discontinue operating under its contract, since low prices for pork had forced the company into bankruptcy, having been compelled to buy its pigs and garbage in a high market and sell them in a lower one. The city officials hope that some arrangement can be made by which the piggery can continue operation, although it does not seem probable that the city can continue to receive any money for the garbage but will probably have to give it to the company or its successor.

Municipal Improvements in Pittsburgh

The director of public works of Pittsburgh, Pa., has stated that on September 1 more than $6,000,000 worth of municipal improvements were under way and bids for an additional million dollars' worth are now being advertised. The work consists of street improvement and playground and sewer construction for the most part. The largest item is $300,000 for improving Brownsville avenue. The Hazlewood sewer system will cost $80,000. Two viaducts on the Boulevard of the Allies are other large pieces of work included in the total.

The Bethlehem Viaduct

The city of Bethlehem, Pa., is building a viaduct which it calls a hill-to-hill bridge, which connects two sections of the city that are divided by a deep valley. This viaduct is said to be the longest structure of the kind in the state. Including four ramps connecting with intersecting streets, it will be 1½ miles long and have a total area of about 7 acres. The four intersected streets will connect with the bridge on each side, giving eight entrances. About 200,000 tons of concrete, 1,700 tons of steel reinforcing and 400,000 granite paving blocks will be used in the construction. The cost has been allocated by the public service commission between the city, the two counties concerned and the railroad interests, the city paying about $500,000, the railroads $600,000 and each of the counties about $600,000, or nearly $2,500,000 total.

St. Louis' Municipal Exhibit

A municipal exhibit is to be held in the public library of St. Louis from October 1 to November 15, at which will be shown the work and methods of work of the various departments and institutions of the city. This exhibit is, we believe, being gotten up by the Municipal Reference Library as a part of its service of education of the citizens.

The Federal Power Commission has issued a permit to the Utah Power & Light Co. for about 21,500 h. p. development on the Bear River in Southeastern Idaho. A permit has also been issued to the Roanoke River Development Co., Richmond, Va., for the construction of a high dam across the Roanoke river at Beggs Island, Clarksville, Va., and a power house with a primary development of about 10,000 h. p. for general utility and industrial purposes.

The city of Chicago has received a permit from the War Department for the extension of the shore line of Grant Park 300 feet into Lake Michigan, permitting the construction of a boulevard from the Field Museum to Jackson Park. The work will be executed under the direction of the South Park Commission that is now making plans for a 200 x 600-foot pier and breakwaters and other structures.

A joint commission of five men from the United States and five from Canada has been appointed for the bridge and tunnel across the Niagara river at Buffalo, the congressional bill for which is now pending.

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Engineers in Public Health Service

Up to a few years ago it was generally held that all matters connected with the public health should be in charge of a physician and among such matters were included sewerage, collecting and disposing of garbage and other matters which have since been taken out of the hands of local health departments. In some cities inspection of house plumbing is still left in the hands of the health department, but the number of these is rapidly decreasing.

There still remains, however, considerable of an engineering feature to the work of health departments, whether local, state or national. So true is this, that health officers who serve as the executives of health boards or departments now receive their training, where any special training for this service is obtained, in engineering schools rather than in medical colleges.

Another indication of this is the great and increasing importance assumed by engineers in the work of the United States Public Health Service. As noted on another page of this issue, during the past eight years the number of sanitary engineers connected with the department have increased from none to 27 and a bill is now before Congress to commission the engineers and place them on the same standing as the medical officers of the service.

One reason for this prominence of engineers in health service is that the chief duty of a public health board is in general that of the prevention of disease while, in spite of much that has been written and said to the contrary, the medical profession still confines itself largely to cure rather than to prevention. Another reason is that prevention includes a considerable amount of engineering work such as the construction of sewers, purification of water, drainage of lands, etc.

It would seem as though an ideal arrangement would be a still further divorcing of the medical and the engineering features of health work, leaving to the health officials only the determination of when and to what extent the health of a community calls for sewerage, water purification, mosquito extermination by drainage, etc., and providing that other departments carry out the engineering features necessary to produce these results.

It is exceptional that a physician is so constituted mentally as to be able to properly direct engineering work or other operations involving the direction of workmen and use of materials, which is so entirely foreign to the duties of either the ordinary practitioner or the specialist in medicine. It would seem more logical therefore to entirely remove from the Public Health Service, which probably will always retain medical men at its head and in the highest official positions, the carrying out of any work calling for engineers, and to place this work in charge of a bureau which is properly officered and organized for carrying out such work.

However, if engineers are to be connected with the service, it is greatly to be hoped that the bill now before Congress will pass, giving them an equal standing with the medical officers and thus attracting to the service a high grade of men such as the country should employ for one of the most important duties that any federal employees are called upon to perform.

Public Works as Temporary Solution of Unemployment

A number of state officials and others throughout the country are advocating the extension of road work in order to give employment to the large number of unemployed labor throughout the country, and some cities and states are doing more or less along this line. For instance, in Bridgeport, Conn., there are said to be about 30,000 unemployed because of the closing down of plants called into existence by war necessities

and the city is endeavoring to give employment to as many as possible of these by doing street grading in outlying sections, where it is not probable that paving will be carried out for some time to come and where consequently the grading might have been postponed for some months or years under other conditions.

A few days ago we received from R. C. Marshall, Jr., general manager of the Associated General Contractors, and who has been appointed by President Harding as a member of the Conference on Unemployment, a request for suggestions as to possible solutions of that problem. In response we submitted the following, and recommend it to the consideration of all state highway officials and others in charge of public works:

So far as unemployment in connection with public works is concerned, it seems to us that the fundamental reason, or at least one of the principal fundamental reasons for such unemployment is the feeling which persists quite generally among officials and taxpayers that manufacturers of and dealers in materials used in such works are attempting to keep prices at a level that is not justified by present conditions and those of the immediate future, and those in charge of public works are holding off in the belief that prices will be materially reduced either this year or next, or else because they feel that, whether or not such early reduction is probable, they cannot afford to undertake any large amount of work at existing prices.

Undoubtedly skilled labor is partly responsible for this in that it is endeavoring not only to retain present wages, but in a number of cases to increase them, and in some trades increases have actually been granted within the past month. There is a general feeling, however, that manufacturers and other employers of skilled labor are as much to blame as labor itself for the failure to lower prices of materials.

If the above opinion is approximately correct, it would seem as though the ultimate solution of the unemployment problem must involve the securing of concerted action by both employers and employees whereby wages and profits will be reduced and business brought back more quickly to approximately a pre-war basis.

This will probably take time, however, and there is need for immediate action. We can think of no way in which employment can be offered on a large scale more promptly than by the construction of public works by cities, counties and states, and especially such classes of work as call for large amount of hand labor. A suggestion is offered by the action of Bridgeport, Conn., where, in view of an estimated number of 30,000 unemployed, many of them semi-skilled men, the city is performing as much street grading as possible, using pick and shovel for this work to a large extent. Other cities might proceed to the carrying out of street opening plans by grading streets which they do not yet feel able to pave, and county and state highway departments might similarly put under way a considerable amount of road grading, although it may be months or possibly years before all of these roads will be surfaced. Many of the states have abundant funds for employing large numbers of men on road work, but have postponed such work because of the high cost of materials.

PASS A FEDERAL ROAD BILL AT ONCE

Other action which could be taken at once, and should be taken at once for other reasons as well as this, is the passing by Congress of a road bill which will provide for continued federal aid to states in road construction. Until such a bill has been passed the states cannot know how much money to count on next year or after their present allotments have been used up, and will therefore be unable to make any plans for the future. Also, some of them whose funds are running low may not wish to completely exhaust these until they learn whether and how much federal aid will be granted them next year.

During the past few weeks a concerted effort has been made to persuade state and county highway officials to complete plans for beginning next year's highway work early in the spring, letting contracts during the fall or winter. This campaign also must fail to a large extent unless definite action is taken very soon by Congress concerning the federal road bill.

With the passing of such a bill and an assurance to the states of continued aid from the federal government, it would seem to be perfectly practicable for them to complete at once a tentative program of road construction and begin immediately thereafter the preliminary grading of the roads selected for early construction; which grading can, over a large part of the country, be continued through the winter, with the exception of a few weeks of severe weather in the northern states. In addition to grading, the opening of gravel and sand pits and stone quarries and the crushing of the stone and distribution of these various materials along the highways for next year's use could proceed during the fall and most of the winter, and thus employment be given to considerable numbers of unskilled and semi-skilled men in all sections of the country.

Award of Costs to Municipality

In New Jersey, at least, it has not been the practice to award costs to a city when a decision in its favor is rendered in the case of a suit brought against it, although costs are frequently awarded to private parties under similar conditions. Recently the Jersey City Water Co. brought suit against Jersey City to recover $500,000 withheld by the city under the terms of a contract for water supplied. Following a decision of the court in favor of the city, the corporation counsel asked the court to allow a counsel fee and Vice-Chancellor Lewis awarded the city $3,000. This money is to go, we understand, to the city treasury and not to the corporation counsel or other legal consultant of the city, and the object in asking for it was chiefly to warn corporations that if they brought unjustifiable suits against the city they would be compelled to pay for doing so.

Water Works Finances, Labor and Meter Rates

Tabulation of supplementary data from cities in all parts of the country relative to meter rates, labor, operating costs and the financial difficulties of present conditions.

In our issue of June 4 of this year we published a table giving data furnished by several hundred water works superintendents in reply to a questionnaire sent by us. A number of replies arrived too late for that issue and belated ones continued to reach us up to the middle of September; but we assume that they are now all in, and are publishing this week a supplementary table giving these later replies.

In the June 18 issue we gave a summary of that part of these data referring to the methods employed by the several departments and companies in meeting cost increases. Further information on this point will be found in these supplementary data; and these and other features we expect to review in a subsequent issue.

WATER WORKS FINANCES, LABOR AND METER RATES

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Alabama:											
Prattville	M	$1.25	10	$2.50	10	$2.50f per quarter	same	....	....	Funds from city treasury	No
Arizona:											
Phoenix	M	3.00	8	2.50	8	.12½g	.12½g	....	....	.....	Distribut'n mains not kept up
California:											
Benicia	P	4.00	8	2.50	8	.60-.35g	same	$238.00	$233.00	Drawing on surplus	No
Chico	P	4.00-5.00	8	2.25-2.50	8	.22-.12f	.11¼-.15f	....	....	Cutting dividends, etc.	No
Eureka	M	4.50	8	2.50	8	.24f; .32g	.30f; 40g	.12½	....	Drawing on surplus	No
Modesto	M	5.00	8	3.00	8	.15g	same	45.00	same	Proceeds of water fund	No
Monrovia	M	4.00	8	....	8	1.00-.05f	.50-.05f	....	....	Funds from treasury—bond issue	....
Pacific Grove	P	3.00-3.50	9	2.25	9	1.10-0.25f	.30-.21f(a)	229.00	201.00	.....	....
Porterville	..	4.00	8	2.50	8	.12½f; 16 2-3g	.18f; .25g	17.50	15.00	.....	No
San Francisco	P	5.00	8	2.50	8	.24-.18f	flat rate	160.00	110.00	Installation of meters and increase in business	No
Santa Paula	P	3.50	9	2.00	9	.07½f	.07½f	....	....	Increasing sales	No
Tulare	M	4.00	8	2.00	8	.10g	.10g	710.00	680.00	Cutting force of employees	Fallen behind
Upland	P	4.00	8	3.00	9	1.00-.10f	1.00-.10f	....	....	More consumers	No
Colorado:											
Delta	M	2.80-3.50	8	2.00-3.00	8	.15g	1.00-.05g	12.40	....	Increased income—more consumers	No
Fort Collins	M	3.20	8	2.40	8	.20g	.15g	....	....	Bond issues	No
Greeley	M	3.50	8	....	..	.20-.06g	....	33.85	....	Raise in rates	No
Monte Vista	M	2.80	8	2.25	10	....	....	....	....	.....	....
Montrose	M	3.20	8	4.00-4.50	11	.30-.10g	same	....	....	Curtailing expenses	....
Connecticut:											
Groton	M	.50	8	.30-.40	8	.25g	.25g	50.00	42.00	.....	No
New Britain	M	.35	9	.17 4-9	9	.10f	.10f	....	....	.....	No
S. Manchester	P	4.05	9	2.00	10	.20 less 10%f	25 less 10%g	119.00	....	.....	No
Waterbury	M	4.00	9	3.00	9	.12-.15½f	.10-.15g	....	....	.....	No
Windsor	M	3.60	9	1.75	9	.25gf	.25f	89.40	80.40(b)	Economy, cutting force	No
Winsted	..	3.00	9	2.00	9	.04-.09g	same	....	....	Reducing help, no extensions	No
Delaware:											
Laurel	..	2.00-2.50	10	1.25-1.50	10	1.00g	.50g	1,000.00	500.00	Increasing rates	Yes
Florida:											
De Land	M	3.00	9	1.50	9	.11f; .15g	.15g	....	....	Raising rates	No
Jacksonville	M	2.60	8	2.00	9	.08-.04f	.08-.04f	10.13	9.44	.....	No
Ocala	M	1.75	9	1.25	9	.12½f	.20f	100.00	....	.....	No
St. Augustine	M	2.50-2.75	8	1.50	8	.06f	.06f	....	....	Funds from city treasury	No
Georgia:											
Gainesville	M	2.00	10	1.25	10	.25g	.15g	55.70	....	Increasing rates	No
Savannah	M	2.50	8	1.50-1.75	8	.90f; .12g	.90f; .12g	15.00	30.00	Funds from city treasury	No
Idaho:											
Coeur d'Alene	P	3.40	8	2.50	10	.10-.40g	same	....	....	Cutting force, drawing on surplus, increase in population	....
Illinois:											
Bloomington	M	3.90	8	2.50	8	.50-.15g	....	117.00	92.00	Raising rates	No
Evanston	M	4.40	8	3.50	8	.12-.05½f	same	....	....	Operating at small deficit	Yes
Harvard	M	4.00	9	3.00	10	.37½f	.37½f	70.00	70.00	.....	....
Morris	M	4.50	9	3.00	10	.20g	.20g	....	....	.....	Somewhat
Normal	M	3.00	10	2.50	10	.26f; .35f	.18f; .25g	....	....	Funds from city treasury	No
Indiana:											
Greensburg	P	4.00	10	2.75	10	.12-.35g	.15-.35g	.19 per 1,000	.12	Cutting maintenance and dividends	Yes
Lafayette	M	95 per mo.	..	$85 per mo.	....	.25g	.20g	68.26	42.60	Increased rates	No

*Where rates are on sliding scale, the highest and lowest are tabulated when reported. a—1916. b—1915. c—1917.

Water Works Finances, Labor and Meter Rates

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Indiana—Continued:											
North Vernon ...	M	3.00	10	2.50	10	no meters	....	$47.20	$20.92	Drawing on surplus and reducing force	Very little
Union City	M	.35	9	2.00	10	.15-.06f	.10-.06f	....	....	.....	No
Iowa:											
Des Moines	M	4.05	9	2.00	9	.30-.10g	same	74.99	74.37	Rate increase	Yes
Fairfield	M	.35-.40	8-10	.25-.30	10	.53 1-3-.18g	.40-.12½g	....	....	Increasing rates	No
Hawarden	M	...	..	2.50	10	.35-.10g	.....	....	....	.....	No
Kansas:											
Beloit	M	.50	8	.25	8	.40-.15g	.25-.10g	80.00	....	Increasing rates	No
Neodesha	M	3.60	8	....	..	.15g	flat rate	....	....	.....	Yes
Louisiana:											
New Orleans	M	.39-.45	8	.25-.32	8	.10-.07g	same	....	....	From surplus	No
Ruston	M	2.00	10	1.50	10	33 1-3-.10g	.25-.10g	....	....	.....	Yes
Maine:											
Farmington	M	3.00	9	2.00	9	....	.....	....	....	.....	No
Houlton	M	3.00	9	2.00	9	.35g	same	17.00	17.00	.....	No
York	P	3.50	8	2.50	9	no meters	.....	....	....	.....	No
Massachusetts:											
Clinton	M	4.50	8	2.00	48 weekly	.25-.06½f less 15%	.25-.06½f less 10%	....	....	.....	No
Dalton	M	...	..	....	....	no meters	.....	gravity	....	.....	No
Hudson	M	4.25	8	2.50	8	.25f	.....	101.00	49.00	Reducing force	No
Lenox	P	4.00	9	2.75	9	.35g	.25g	....	....	Raising rates	No
Manchester	M	4.80	8	3.20	8	.20f	.20f	....	....	From treasury	No
Medway	M	4.00	8	2.00	9	.30f	.30f	....	....	.....	....
Pepperell	M	3.50	8	1.75	8	.45g	.40g	102.92	66.70	.....	No
Sutton	P	3.20	8	1.75	9	1.00-.50g	same	....	....	.....	No
Swampscott	M	5.00	8	3.00	8	.30f	.40f	....	....	Increased rates	No
Winthrop	M	4.00	8	2.50	8	.15f; .20g	same	....	....	Reducing costs and help	No
Michigan:											
Belding	M	3.50	9	2.00	10	.15f	.11f	....	.07	From city treasury	No
Boyne City	M	20 per wk.	10	1.75	10	.15g	.15g	....	....	.....	Yes
Lansing	M	.40-.50	9	.20-.22½	9	....	.....	....	....	Increased rates, bond issue	No
Marshall	M	.50	9	.40	9	10-.20g	same f	....	....	.....	No
Pawpaw	..	4.00	10	2.50	10	16-.18g	.12-.16g	....	....	.....	....
St. Clair	M	4.50	8	3.00-3.50	10	.12½-.05g	same	7.00	2½	Surplus and city treasury	Yes
Traverse City ...	M	4.00	10	3.00	10	.06f	same	....	....	From earnings	No
Yale	M	4.00	10	.27½-.80	10	.15-.05f	same	....	....	Raising rates	Yes
Minnesota:											
Detroit	M	3.00	10	2.50-3.00	10	.25f	same	....	....	Raised rates	No
Ely	M	4.75-5.00	8	3.00-3.50	8	.25-.05f	.....	....	....	.....	No
Mankato	M	3.50	10	2.00	10	.09-.045f	same	91.03(c)	....	City funds	Yes
Moorhead	M	4.00	8	2.00-3.25	9	.40-.05f	same	....	....	Increased consumption	No
Worthington	M	.30-.40	10	.30-.40	10	.30g	same	....	....	Bond issues, revenue from plant	No
Mississippi:											
Brookhaven	M	2.00	10	3.00	10	.30-.20g	.20-.15g	.07	.04	Increased rates, funds from other departments	No
Greenwood	M	1.50-2.00	10	1.25-1.50	10	.27-.08g	flat rate	25.00	....	Incr. rates—reducing consumption	Somewhat
Missouri:											
De Soto	M	.40	8	.20	8	.50-.11f	.25-.08f	....	....	Raising rate	Yes
Fulton	M	3.20	8	2.00	10	.30f; .40g	.25f; .33 1-3 g	....	....	Drawing from surplus and increasing rates	No
Kansas City	M	4.40	8	2.00	8	.17-.678f	.17-.825f	70.87	55.49	Drawing on surplus and reducing free consumption	Yes
St. Louis	M	.35-.58	8	.25	8	....	.....	57.26	31.76	Drawing on surplus, cutting force	No

c—1917

Construction Questions Answered

Suggestions as to methods, "wrinkles"and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Small Earth Tunnels—II*

Use of poling boards and bulkheads. Enlarging cross section. Shield method, air lock, lining, ventilating.

Small headings about 6 feet wide and high can be driven through very treacherous material like fine, loose, dry sand or gravel with ordinary methods and timbering, supplemented by the use of poling boards. These are generally short pieces of narrow 2-inch planks, that are driven horizontally as far as possible into the earth in advance of the excavation.

For the roof of the tunnel, they are driven over the top of the last timber cap that is set and are inclined upward very slightly and are hammered or jacked forward as fast as the excavation progresses so as to penetrate a little beyond the excavation and seal the latter as much as possible. They are usually made a little longer than the distance between the bents, and the forward end is supported on the top of the next bent above a second series of poling boards that is started next to the cap timber and driven between it and the preceding set of poling boards so that the latter always resemble successive courses of overlapping shingles.

SIDE BOARDS

When the ground is very bad there is a tendency for the vertical sides of the drift to fall inward, and poling boards, similar to those in the roof can be driven on the exterior of the vertical posts. Often, however, horizontal longitudinal side boards can be successively set outside the posts without driving, breaking joints on post centers, as excavation proceeds. In either case it may be necessary to brace apart the bottoms of the vertical posts by horizontal struts at or below the floor level.

This precaution serves to resist unbalanced horizontal pressure on the sides of the tunnel, that in some cases becomes very heavy, as for instance in small headings drifted through blue clay under Boston harbor, where the material swelled by exposure to the atmosphere and exerted a pressure so heavy as to force the longitudinal timbers ½ inch into the faces of the vertical posts that they separated.

*Part I—Preliminaries, comparative trenching and backfilling, pipe tunnels, drifting, excavating, mucking and timbering was published Sept. 24.

BULKHEADS

If the soil is very loose or unstable or if there is a heavy flow of ground water in the stratum excavated, it may be necessary to reduce the exposed surface of the heading to the minimum, which can be done by the use of transverse bulkheads consisting of horizontal transverse boards set, from bottom up, across the heading against the vertical or offset stakes and braced back to the assembled timbering by horizontal and inclined struts. The boards can then be removed one at a time from the top down, allowing the miners to withdraw small quantities of unstable earth or sand from under the ends of the roof boards, allowing the latter and the side boards, from the top down, to be advanced to correspond with the excavation and gradually working down with the latter from the roof to the floor of the tunnel.

Sometimes there is so much ground water or the soil runs so easily that it is also necessary to keep on hand a quantity of hay, straw or its equivalent to force through any cracks or cavities that may appear.

ENLARGING THE CROSS SECTION

If it is necessary to give the tunnel greater width than that of the original drift it can be done by widening the latter on one or both ends. If the ground is good this can be done without interfering with the original roof boards or timbering and additional posts and caps can be set as required to support the roof extensions. With loose ground it may be necessary to excavate under the protection of poling boards, driven as described for the roof except that in this case the boards will have to be supported on beams parallel with the tunnel axis.

In tunnels more than 10 to 12 feet wide, such excavation is usually accomplished by standard methods known as the crown bar methods, subject to modifications, and should be handled by experienced miners. Where the width or height of the tunnel is greater than can advantageously be excavated in a single operation it is frequently advantageous to excavate earth in a narrow transverse segment and install timbering to support the entire roof and afterwards continue the excavation to the bottom of the tunnel floor, replacing the vertical posts with longer ones or underpinning or blocking them as the work progresses. When drifts on both sides are carried down to the full depth of the tunnel excavation and are connected by transverse excavation close to the roof, the earth subsequently excavated between the longitudinal side drifts is called the dumpling,

and is handled much more easily and rapidly than that excavated in the drifts.

SHIELD METHODS

A long tunnel in very loose, treacherous ground, especially if it is to be provided with a permanent iron, steel, or brick lining, may often be advantageously excavated by the shield method, which generally, although not necessarily, involves a circular cross section. In this case the shield consists of a riveted steel cylinder with a diameter just sufficient to give clearance over the outside of the finished permanent lining and of a length usually somewhat longer than its diameter. The forward end of the shield is usually reinforced by stiffening plates and braces on the cylindrical cutting edge. The whole forward end may be closed by a vertical transverse diaphragm having openings in it that can be closed by movable doors.

A rigid annular framework in the rear of the shield provides support for a number of circumferential horizontal hydraulic jacks that can be made to react against the forward end of the finished lining, which must always project a short distance inside the rear end or tail of the shield. The shield being put in position concentric with the axis of the tunnel is advanced by operating the hydraulic jacks simultaneously with or immediately subsequent to excavation through the openings in the forward end.

As fast as the shield advances a distance equal to the length of one section in the segmental tunnel lining, the latter is assembled in place inside the tail of the shield, the jacks replaced with bearings against the completed lining, and operations repeated, thus enabling the workmen to be always completely protected above, in front and on the sides and bottom of the headings by the movable steel shield telescoped over the forward ends of the lining.

The shield method is used for the excavation of tunnels of all diameters from the smallest to the largest, and is particularly advantageous in very wet, soft ground, being almost always used for subaqueous tunneling in mud, sand, clay, gravel or the like. It can be used to advantage in some loose, dry materials, and is almost indispensible where there is a great flow of water or soft material. In such cases it is generally accompanied by pneumatic pressure which, so long as it is properly maintained, excludes the water. Shields are sometimes used for the roof alone, but in that case it is for tunnels of considerable width and the side walls are usually built in drifts in advance of the shield.

AIR LOCK

In order to apply the pneumatic pressure it is necessary to install an efficient air compressor plant with a reserve machine, and to provide a substantial bulkhead and air lock at the entrance of the tunnel. The bulkhead must be strong enough to resist heavy unbalanced pressure, and be sealed airtight to the permanent lining of the tunnel. The air lock must be adapted for the transmission of all men, plant, supplies and materials needed in the tunnel and for exit of excavated material.

Usually the air lock is a riveted steel cylinder about 6 feet in diameter and 10 feet or more in length, with an airtight door at each end opening away from the heading and never both open simultaneously. The use of the pneumatic and shield methods combined enables tunnels to be driven through quicksand, through silt and through the very difficult combination of gravel, boulders, sand and water where the work could not be accomplished by any other method. Pneumatic tunneling is, of course, very slow and costly and requires special safeguards in case of accident. It should be used only under the direction of experienced men and often may be dispensed with during a large portion of the work and only applied for short periods or distances at critical times.

TUNNEL LININGS

For circular shield-driven tunnels, the lining almost always consists of segmental cast iron plates fastened together with internal flanges bolted on all four sides, thus forming a complete cylindrical shell, which is generally lined with concrete on the inside. There has recently been designed and used an equivalent lining made of pre-cast concrete blocks, which can be manufactured at the tunnel site, saving time and expense. Both the cast iron and the concrete segments are so heavy that they require special power appliances for assembling them in a tunnel, even one of small diameter. In some cases they can be replaced by much lighter and cheaper segments made of successive short wooden planks like scarf boards, cut to the curve and spiked together with staggered joints so as to make a continuous structure.

Circular tunnels excavated with or without a shield may also be sometimes and advantageously lined in a manner similar to that using the cast iron segments, with pressed steel segmental plates corresponding to the cast iron plates, but very much lighter. These plates are generally left permanent in the ground and are then also usually covered with an interior coating of concrete, although it is possible that in some cases they might be removed where the ground is exceptionally strong.

Where tunnels are lined with concrete only, the latter may be placed in any convenient type of forms, including wooden forms built by the contractor himself and knocked down or advanced in sections according to circumstances. There are, however, standard forms carefully designed by experts and usually provided with adjustments and movable supports so that they can be easily stripped and moved ahead for more rapid and economical operation, that can be purchased or rented from regular makers. These are especially valuable for long tangents; on curves or irregular places, wooden forms are more likely to be suitable.

CONCRETING LINING

In small tunnels great difficulty is likely to be encountered from obstructions caused by attempts to deliver concrete in buckets or dump cars and by unloading the latter. If this method is unavoidable, special precautions must be taken to make the apparatus very compact and provide clearances for the other work to go on simul-

taneously. As the amount of concrete is comparatively small and the cost necessarily high, it is most generally found to be not only justifiable, but almost necessary to transport and deposit the concrete by pneumatic pressure, which can convey it many hundreds of feet through pipes from 4 to 6 inches in diameter, carrying it around curves and up or down through vertical or inclined sections of pipe. This process uses a considerable amount of compressed air, but is very convenient and efficient if properly handled.

LIGHTING AND VENTILATION

Tunnels are, of course, lighted by electric lamps and electric power is often used for pumping, hauling and other purposes, including drilling if small quantities of rock happen to be encountered. Care must be taken to keep the electric wires out of the way and when there is any danger of encountering explosive gases, special care must be taken to prevent explosion from electric sparks.

In some strata quantities of poisonous and explosive gases are encountered, which are often colorless, tasteless and odorless and are therefore very difficult to detect. These gases are usually heavier than air and settle in the low places, where they may be retained for a long time and gradually accumulate and sometimes cause very serious or fatal explosions, fires or suffocations. In certain proportions the gases mixed with the air are harmless and in other proportions are highly explosive. Tests of the air in the tunnel should be frequently made from samples which are easily collected by bringing bottles filled with water into the tunnel and emptying them in various parts and then sealing them and delivering them for laboratory examination. When gas is detected it must be removed by thorough ventilation, which is best accomplished by forcing large quantities of compressed air into the heading and pumping out air from the rear part of the tunnel.

New Water Supply for Glen Ridge

At a meeting of the borough council of Glen Ridge, N. J., on September 13, the mayor announced that arrangements had been made and a contract signed for obtaining a new supply of water for the borough. The contract had been made with the Butler Water Co., the supply to come from Apshewa river, a tributary of the Pequannock below the point where Newark gets its water. The company had previously been obtaining its supply from the East Jersey Water Co. under a contract which expired some time ago. It is reported that the borough will pay the water company $50 per million gallons for the water, and will pay the city of Newark $35 per million gallons for transporting it across that city from the mains of the Butler Water Co., and in addition will pay the East Jersey Water Co. $15 per million gallons as a stand-by charge for maintaining arrangements for serving the borough in cases of emergency. The consumers of the borough will be charged 2½ cents per 100 cubic feet. Formerly the consumers were charged 2 cents.

The borough has been seeking to obtain a new supply for several years. Test wells were bored with a view to using ground water but this was decided against and after negotiations with several companies the contract above referred to was arranged.

Proposed Subway and Tunnel for Habana Cuba

Plans for a subway system and tunnel for the city of Habana have been approved by the Cuban Railroad Commission, and the Cuba North & South Railroad Co. has been organized to promote this project. A representative of the firm of engineers in charge (Sr. Serafin Sanchez Govin, No. 62 Villegas street Habana), holding full power of attorney to act for the Cuba North & South Railroad Co., is expected to go to New York in October or November to arrange for the necessary capital and invites correspondence regarding either the structural or the investment possibilities of the project.

Protecting Wood Piles from Teredos

Piles driven in the Pacific ocean at Fort Orford, Ore., are so rapidly injured by the teredos that they had to be replaced on the average of once a year, therefore about 125 fir piles about 50 feet long that were driven last season to a penetration of about 20 feet in very hard clay that required previous blasting were enclosed below low water level with a casing of 14-gage Armco corrugated wrought iron cylinders, 24 inches in diameter, dipped in a special asphaltic mixture. After the piles were driven the protecting cylinders, riveted together at the site, were slipped over the tops of the piles and driven some distance into the bottom by 8-inch strokes of a 6,650-pound hammer, after which the annular space between the pile and the jacket was filled with concrete.

$10,000,000 Pipe Line to Be Constructed in Mexico

A concession has been granted to C. E. Yerby, Los Angeles, for the construction of a $10,000,000 pipe line to follow the route of the Puerto railroad from Puerto, Mexico, on the gulf coast, to Salina Cruz on the Pacific coast. Work will be immediately commenced on the construction of a 10-inch line, which will be completed about two years from now and will be followed by other lines, at a total cost of about ten million dollars. One half of the total capacity of the line will be operated under the Mexican Federal legislation governing common carriers and the remainder of their capacity will be subject to contract by the operating company. By the use of this line the cost of oil will be cheapened for consumers in Mexico, in the Pacific states oil will be more available for fuel stations, and a saving of 11 days' time will be made in the transportation of oil across Mexico and of 2,300 miles in the distance required for its transportation through the Panama Canal. The air line distance between the pipe line terminals is about 135 miles.

NEWS OF THE SOCIETIES

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 3-7 — AMERICAN ELECTRIC RAILWAY ASSOCIATION. Atlantic City, N. J.

Oct. 5-7 — SOCIETY OF INDUSTRIAL ENGINEERS, National convention. Springfield, Mass.

Oct. 8—BROOKLYN ENGINEERS' CLUB. Dinner. Chamber of Commerce.

Oct. 11-14 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash. Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14 — LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz, University of Kansas.

Oct. 20-21 — CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, St. Petersburg, Fla.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

CANADIAN HIGHWAY ASSOCIATION

In order to encourage the promotion of a continuous highway across the Dominion from Cape Scott at the northern extremity of Vancouver to the most easterly extremity of Nova Scotia, the Canadian Highway Association was formed last month. John L. Beckwith was elected president; Lord Byng, Hon. Arthur Meighen and Premier Oliver asked to act as patrons; Samuel Hill of Seattle, international good roads enthusiast, was chosen as honorary president; and F. R. McD. Russell of Vancouver, Reeve Sam J. Drake of Oak Bay, and Alderman A. E. Todd of Victoria made vice-presidents.

ONTARIO TOWN PLANNING AND HOUSING ASSOCIATION

A convention of the Ontario Town Planning and Housing Association is planned for the latter part of October at Massey Hall, Toronto, at which a large number of delegates will be in attendance from all parts of Ontario. At the convention it is expected that several experts of the Chicago City Planning Commission will deliver addresses; and papers will be read by Dr. H. L. Brittain of Toronto and G. W. McLaughlin of Oshawa. All problems which affect growing municipalities will be taken up, and the Dominion and Provincial governments asked for aid in the work.

INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS

The eighth annual meeting of the International Association of Industrial Accident Boards and Commissions was held in Chicago on September 19-23 at the Hotel La Salle. The convention opened at two o'clock Monday afternoon with Charles S. Andrus, president, as chairman. Addresses of welcome were delivered, and the subject "Administrative Problems Under State Funds" discussed. On Tuesday morning an accident prevention meeting was held; there were also interesting meetings on Wednesday and Thursday, at which the society was addressed by well-known speakers; and on Friday morning the report of the Committee on Resolutions was read.

NATIONAL SAFETY COUNCIL

The tenth annual congress of the National Safety Council was held at the Massachusetts State House, Boston, Mass., on September 26-30th. As has been the custom at past congresses, the delegates from the various industries met in separate sectional meetings with others of their own group for special problems relating to their own industries, as well as at the general meeting, in which the representatives of all industries joined. These special meetings were held for the automotive, chemical, construction, electric railway, metal and pulp, public utilities, rubber, steam railroad, textile and woodworking industries. There were also meetings of the education, engineering, health service, public safety, and women in industry sections of the National Safety Council.

SEATTLE CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

The Seattle chapter, A. A. E., entertained C. E. Drayer, national secretary of the A. A. E., at its meeting on the evening of September 16th. This meeting was preceded by an informal dinner at the Elks' Club with Mr. Drayer as guest. At the meeting Secretary Drayer spoke on "The Broader Field for Engineering Service."

MEETING OF WORLD'S ENGINEERS

Delegates from various engineering societies in England, France and America will meet at the Engineers' Club, New York City, on the evening of October 10th to "establish a new international contact which shall promote concord among the English-speaking countries, advance the science of engineering and work along conservative lines for the establishment of international peace." The meeting will also celebrate the return of the American engineers who went abroad to confer the John Fritz medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Invitations to this meeting have been extended to many men prominent in public life, including Herbert Hoover, Viscount Bryce and Charles E. Hughes.

DULUTH ENGINEERS' CLUB

G. H. Herrold, managing director of the city planning board of St. Paul addressed the regular meeting of the Duluth Engineers' Club held on September 19th. The meeting was opened by an informal dinner at the Commercial Club, after which the regular meeting was held. Mr. Herrold discussed the questions, what city planning boards are, how they are appointed, what authority they have and the work that has been done in general; all of which, though with special reference to the work of the St. Paul board, was of broad general interest.

WESTERN SOCIETY OF ENGINEERS

The Western Society of Engineers was addressed on September 12th by A. R. Hirst, state highway engineer of Wisconsin, on "Developing a System of Highway Transportation to Serve the People of a State"; on September 19th by Arthur E. Morgan, former chief engineer of the Miami Conservancy District on "Dayton Flood Control," and on September 26th, chief engineers' night, by C. A. Morse, A. S. Baldwin, H. R. Safford, C. F. Loweth and E. J. Lee on their experiences of the different railroad systems with which they are connected.

ALLIED ENGINEERS' ASSOCIATION

The Allied Engineering Association, Charleston, S. C., has announced for the season the following papers: Oct. 17, "The Auto Truck—Its Use in Construction Work," by Lt.-Col. Eugene Kelly; Dec. 19, "Rebuilding Filter Plant, Charleston Water Department," by Francis D. McDowell, Jr.; Jan. 16, "The Engineer and the Financier," by E. H. Pringle, Jr.; Feb. 20, "Concrete Roads," by James W. Martin; March 20, "Construction of Bridge Piers for the New Santee River Bridge," by J. Bryce LaBruce; April 17, "Railroad Problems," by J. P. Walker; May 15, "Paving of City Streets," by J. H. Dingle.

The officers of this association are: President, J. E. Gibson; vice-president, W. L. Whitescarver; secretary and treasurer, T. A. Burbridge.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HYDRAULIC DREDGES

The hydraulic dredges for river, harbor and canal excavation and land reclamation, designed and constructed by the Bucyrus Company, are claimed to be manufactured by the only firm in the world that has specialized in the design and construction of the heavier high-power hydraulic dredges and that has built more of that type than any other manufacturer. For 40 years this company has studied the performance of dredges in all kinds of operations and claims to develop the most durable and efficient machinery units for this class of work.

The construction of the New York State Barge canal gave the Bucyrus Company opportunity to demonstrate their theories, and the five 20-inch hydraulic dredges of their make that were used on that work successfully handled cemented gravel and small boulders previously considered impossible for a dredge of this type. Since then, this heavy type of dredge has been steadily developed and improved. As an illustration thereof, the cutter on one of their large hydraulic dredges has been operated under 600 electrical h. p., which was 100 per cent in excess of the normal rating of its motor.

Bulletin H-101 recommends the use of the hydraulic dredge on improvement and construction work where the material encountered does not contain boulders that require blasting or are too large to pass through the pipe and where a suitable spoil area can be found within the radius of 1 mile from the point of excavation, although there are records of these dredges pumping materials through a line more than 1,000 feet long to an elevation of 90 feet with the aid of two booster pumps.

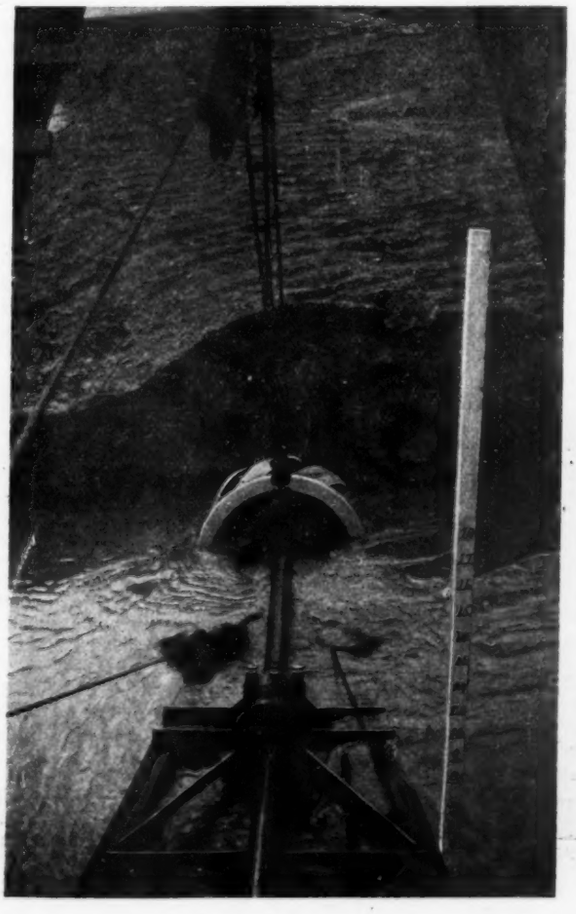
The casing of the standard horizontal single suction type pump is a single casting designed for maximum strength, durability and ultimate economy, with thickness up to 5 inches in the zone of maximum wear. The suction pump has a renewable casting bolted to the front head. All parts of the pump which come in contact with the dredged material are made of special nickel chrome steel which has proven very serviceable in this class of work. The shaft is fitted with a renewable sleeve where it passes through the water sealed stuffing box.

For suction and discharge piping, nickel chrome or high carbon steel castings from ¾ inch to 1 inch thick are recommended and are designed to include a minimum number of elbows and bends.

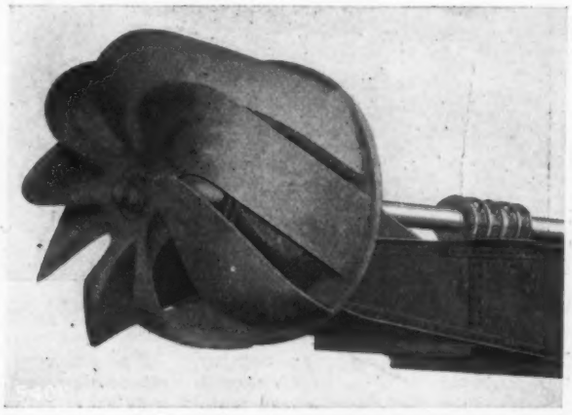
It is recommended that a cutter head with five to eight spiral blades be installed with every suction pipe. It is mounted together with a driving shaft and the suction pipe on a plate girder ladder suspended by wire rope tackles from a bow jib or A-frame mounted on the deck.

A 5-drum winch is provided for hoisting the ladder and the spuds and for swinging the dredge. Each drum is bronze bushed and mounted loose on its shaft and is engaged by means of a friction clutch of the outside band or internal expansion type and actuated by steam or air cylinders. The dredges may be designed to operate with steam or electric power.

The bulletin contains a list of data necessary to permit a satisfactory estimate on a dredge. It is illustrated with halftone engravings of a number of large hydraulic dredges installed on important operations.



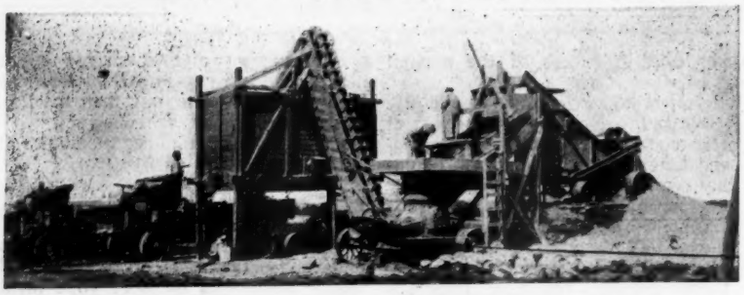
THE CUTTER HEAD IN ACTION



HEAVY 8-BLADE CUTTER HEAD DESIGNED FOR HEAVY DIGGING

TYPE OF CUTTER HEAD USED FOR EXCEPTIONALLY HEAVY DREDGING WHERE MATERIAL IS EXTREMELY COMPACT OR BOULDERS PREVAIL

INDUSTRIAL NOTES



EXCAVATOR AND PORTABLE ROCK CRUSHER AT THE GREEN LAKE COUNTY GRAVEL PLANT, MANCHESTER, WIS

PORTABLE GRAVEL PLANTS FOR HIGHWAY WORK

Gravel for the construction of 26 miles of highway in Green Lake County, Wis., has been derived from local pits by the use of two portable plants, each of them including one 20-h. p., Minneapolis Steam Tractor, one Allis Chalmers Portable Gyratory Crusher, one bucket elevator, one Smith excavator and loader, and two 10-yard material bins and screens.

EXCAVATING 10,000 YARDS OF GRAVEL FROM THE MANCHESTER PIT WITHOUT MOVING POSITION OF EXCAVATOR

The first plant was installed near Manchester in a deposit of excellent gravel, which did not need screening and was delivered by 5 Quad and 4-wheel drive trucks with each crusher that handled an average of 125 to 137 yards daily, an amount below the capacity of the plant. After producing about 10,000 yards of sand and gravel the entire plant was removed without difficulty to another pit and resumed operations there.

The efficiency of this plant was so satisfactory that a duplicate plant was installed at Dalton, about 7 miles away, and excavated about 4,000 yards of gravel, after which it was moved 100 yards to another pit, containing about 10,000 yards.

The standard excavator and loader machine, operated by its own 18 h. p. gasoline engine, is installed at the edge of the pit and at an elevation of about 4 feet above the surface of the ground, operates a dragline excavator bucket with a radius of 150 feet. The excavator delivers to a stone crusher and the product of the latter is elevated by a bucket conveyor to the screens or direct to the storage bins, both crusher and conveyor being operated by the same tractor that hauls the plant from place to place as required. With a force consisting of foreman, excavator operator, crusher man, tractor operator, loading bin man and two or three men in the pit, a production of about 200 yards per day is attained.

THE SECOND PLANT AT DALTON, ABOUT 15 MILES FROM MANCHESTER

Similar plants are being operated by other counties in Minnesota, the advantages claimed being small investment, low operating costs, minimum labor, portability, location of plant outside of the pit, loading of wagons and trucks on the surface of the ground rather than in the pit, applicability for small gravel deposits or combinations of several units to work large deposits and the ability of the excavator to plow, dig, haul and load any type of soil, thus enabling it to do its own stripping.

CHANGE OF NAME

The corporate name of the Snare & Triest Company, New York, has been changed to the Frederick Snare Corporation, which will continue the general engineering construction business with the same staff. This concern was organized in 1900, since which time it has completed more than 1,200 contracts in the United States, Cuba, the West Indies and South America, including piers, bulk heads, break waters, jetties, ferry terminals, bridges, reservoirs, pipe lines, elevated railroads, power plants, dams, tunnels, coaling plants and other important engineering constructions.

WOOD PRESERVATION BUREAU

The American Wood Preservers Association, with a membership of 37 or more, including several lumber companies and 15 creosoting or wood preserving companies, has established a service bureau to promote the use of wood properly treated to resist marine borers and insect attacks, and maintains the bureau at 1146 Otis Building, Chicago, to answer inquiries regarding the treatment of wood and the use of treated timber; to disseminate information on the preservation treatment of wood; to furnish reliable information on the durability of treated and untreated wood; to show where these materials have proved satisfactory; to give information on causes and remedies for deterioration of wooden structures, and to show how treated wood can be used economically when substitutes are being considered.

Harold B. Wood has been placed in charge of the New York office of the Jeffrey Manufacturing Co., of Columbus, Ohio.

The Clyde Iron Works Sales Co., of Duluth, Minn., has placed its Pittsburgh agencies with the John H. Carline Machinery Co. of that city.